placement conditions that they decided were not representative of rural companies. While the log files indicate that no low-cost contracts were excluded from the analysis, a number of high-cost contracts were explicitly excluded, regardless of why the contract costs were high.[31] For example, contract CONT 578TX was eliminated "because the costs are quite high and I don't know what is driving the high costs."[32] Project MT529 in the buried copper analysis was also removed due to the high cost associated with cutting through roads and controlling traffic, conditions likely to be prevalent in a typical non-rural serving area.[33] Since rural companies experience conditions associated with high placement costs, albeit not as frequently as non-rural carriers, editing the high-cost observations from the data used by the NRRI Study makes its results unrepresentative of rural companies' costs, and even less representative of the costs of non-rural carriers.

a) Invalidity of RUS data.

Besides the limited number of data points used to estimate certain regression equations and the exclusion of high-cost observations from the overall analysis, the handling of sharing and splicing costs further suggests that the RUS data cannot be relied upon.

The NRRI Study presents conflicting evidence with regard to the treatment of structure sharing in the regression data. The NRRI Study's authors state that the contracts used as the basis for the regression do not indicate the degree to which the

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[31] *Id.* at p. 39, ¶ 2.

[32] *Id.*, HM Regression Log for Cables, Drops, Poles, p. 5.

[33] *Id.*, Chapter 2, p. 39.

final contract prices reflect sharing.[34] But they also indicate that, at least in the case of buried structure, the buried cable costs reported in the data largely reflect the costs incurred after taking sharing into account.[35] It is therefore difficult to determine the extent of sharing that has been reflected in the data. Since the Model uses separate inputs to account for the sharing of outside plant structure, relying on the RUS data as the basis of structure costs may result in double counting the effect of sharing for certain facilities -- once in the underlying data and again through the Model's structure sharing algorithms.

It is also not clear whether splicing costs are included in the data underlying the NRRI Study. The authors state that splicing and company engineering are excluded; yet, they also say that splicing was added.[36] If splicing costs are reflected in the data, then the FCC's proposed loading factor for splicing would account for splicing costs a second time.[37]

Substantial unexplained variations in the unit costs exist in the RUS data set, creating added concern about its accuracy. In one case, the material unit cost for six-pair cable is between $0.10 and $1.74 per foot. In another, the labor cost for the same kind of cable is between $0.10 and $6.50. These and other variances between low and high estimates are shown in Table 1 below:

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[34] *Id.* at p. 32, ¶ 4.

[35] *Id.* at p. 33, ¶ 1.

[36] *Id.* at p. 31, ¶ 3; p. 46, ¶ 3.

[37] FNPRM at ¶ 81.

Table 1
Examples of Variances Between
Low and High Estimates for Labor and Materials

Cable Gauge	Number of Pairs	Minimum Unit Cost of Labor	Maximum Unit Cost of Labor	Minimum Unit Cost of Materials	Maximum Unit Cost of Materials
24	6	0.10	6.50	0.10	1.74
24	25	0.07	6.50	0.08	8.28
24	50	0.07	6.50	0.31	8.54
24	100	0.10	9.80	0.17	24.55
24	200	0.10	9.80	1.07	4.22
24	600	0.10	6.00	0.54	12.22
24	900	0.10	8.00	0.54	17.73
24	1200	0.10	12.80	7.25	23.53
24	1500	0.50	6.00	9.29	30.00
24	1800	0.80	6.00	11.25	23.80

These variations may result from the fact that the data set was not designed for its proposed use. In particular, GTE questions the use of RUS company contracts for various types of work as the basis for the data in the NRRI Study. Because the RUS company contracts usually do not list *actual unit costs* for work performed, but rather a total cost for the project, the NRRI Study must arbitrarily allocate specific unit costs even when separate identification of the costs does not exist.[38] In addition, the NRRI Study's authors eliminated loading costs from some contracts due to uncertainty on how to assign them. These excluded loading costs can be as high as 10.44% of the entire contract amount.[39] Consequently, the RUS data do not account for many of the costs that even a rural LEC would incur, and it is practically impossible to determine the

[38] An example of this arbitrary allocation is illustrated in the allocation of loading costs to material costs. *See* NRRI Study at p. 26, ¶ 1.

[39] NRRI Study, Chapter 2, CONT T-112, Table 2-4, at p. 25.

accuracy of the unit costs of the piece parts. However, an accurate assignment of unit costs based on the total contract cost is exactly what use of the RUS data in the regression equations requires.

The limited number of observations used in some equations, the removal of high-cost contracts, the significant variation observed in the unit costs for the remaining data, as well as the fact that the data set was not designed for its proposed use, all speak to the unsuitability of the RUS data as a basis for determining the material and placement costs of a non-rural carrier's outside plant. Even assuming the data are adequate for estimating the costs of rural carriers, differences between rural and non-rural carriers, and the authors' admitted reluctance to extend the use of the data beyond rural carriers, make it clear that the RUS data are not suitable for the purpose intended by the Commission.

2. The NRRI Study Suffers From Methodological Flaws That Render It Unsuitable For Developing Input Values.

Setting aside the problems with the RUS data, the NRRI Study contains three methodological errors that make its results unreliable: the averaging of ordinal data; the determination of placement costs based on soil type; and mismatched dependent and independent variables. In both its original form and in the altered form proposed by the Commission, the NRRI Study cannot be used to estimate the costs of any non-rural local exchange carrier.

a) Averaging of ordinal data.

The most serious of the three methodological flaws in the NRRI Study is the averaging of ordinal or categorical data. Many independent variables dealing with characteristics such as bedrock and water depth appear in NRRI Study equations as weighted averages of categorical or ordinal data. Ordinal variables generally take on a small number of values, such as 1 for normal soil, 2 for soft rock soil, and 3 for hard rock soil. In this example, these values indicate only the ranking of soil types in terms of hardness. They do not indicate that hard rock soil is three times "harder" than normal soil, or that it is three times more costly to place cable in hard rock soil. Yet, both the NRRI Study and the FCC assume that such relationships are represented by the ordinal data.

Averaging ordinal data is a fundamental error often discussed in econometrics textbooks. In discussing an example in which an independent variable relates to educational levels, Jan Kmenta notes: "that the trichotomy in the preceding model is represented by *two* binary variables, each assuming a value of 0 or 1. It would be incorrect to use *one* variable with three values, say, 0 for a B.A., 1 for an M.A., and 2 for a Ph.D."[40] Similarly, in writing about an example dealing with the output of three different machines, Robert Pindyck and Daniel Rubinfeld state:

> [t]he three alternative production processes were represented by two dummy variables (with the third implicit). Representing such a phenomenon by one variable taking on three values (e.g., machine A = 2, machine B = 1, machine C = 0) is not equivalent to the dummy variable technique unless the differences between outputs associated with the machine C-to-A and machine C-to-B comparisons are identical. In general, there is no reason to make such an assumption.[41]

Both the FCC and the NRRI Study use the bedrock and water depth variables in the regressions as if they were continuous rather than ordinal variables. The result is

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[40] J. Kmenta, *Elements of Econometrics*, p. 412 (1971) (emphasis in original).

[41] R.S. Pindyck and D.L. Rubinfeld, *Econometric Models and Economic Forecasts*, p. 79 (1976).

that the regressions impose unsupported relationships between costs, on one hand, and bedrock and water depth characteristics, on the other. For example, the FCC's regression for estimating the cost of 40 foot, class four poles restricts the impact of hard rock on cost to be double that of soft rock, even though the ordinal data underlying the regression do not contain this information.

b) Placement costs by soil type.

The second major flaw is the NRRI Study's reliance on the HAI Model's variable relating to soil type. The HAI Model soil surface variable takes nine values corresponding to over 250 surface conditions ranging from "normal" to "very slatey." Ostensibly, this variable represents the increase in placement costs for buried and underground plant for each of the 250-plus soil conditions. The HAI Model measure is used in the NRRI Study, for example, as the variable "sstare15," which is a weighted average of the HAI Model's soil surface indicator variable minus 1, with the weights based on the area of the Census Block Groups ("CBGs") associated with each company.

At first glance, this HAI Model variable is more than just an ordinal measure. Moreover, the values used in the HAI Model were "made up" by Dean Fassett (an engineer who helped develop the HAI Model) in response to a request by the FCC staff.[42] Consequently, the "made up" variable is judgmental, biased and ordinal in

[42] *See* Attachment 2, E-mail from John C. Donovan to Dean Fassett, dated January 19, 1997. The "made up" values for the soil surface variable by Mr. Fassett are the same ones used by the NRRI Study and by the FCC's proposal in the FNPRM.

nature, and using the weighted average for each company as an independent variable repeats the flaw noted above.

c) Mismatched dependent and independent variables.

Finally, even if the bedrock and water depth variables were not ordinal, and even if the HAI Model soil surface variable truly measured differences in placement costs, the NRRI Study is flawed because of a mismatch in the geographic coverage of the RUS data and the HAI Model variables. The RUS data presumably correspond to individual construction jobs within a single CBG, while the independent variables based on the HAI Model, including the density measures, are company-wide averages based on the CBGs of each company's serving territory. For example, the Cobbosseecontee Telephone Company (a rural carrier) operates in three CBGs in Maine, but only one pole placement record for this company appears in the RUS database. No matter how much meaning is contained in the values used to code the HAI Model variable for each CBG, the record used in the pole equation can correspond to only one of the three CBGs. The approach taken by the NRRI Study attempts to wring more information out of the underlying data than actually exists, and little meaning can therefore be ascribed to the results. Because the Commission's input proposals carry forward the same mismatch between the RUS data set observations and the company-wide averages of terrain and other data, it, too, is flawed.

3. The FCC's Modifications Do Not Solve The Problems With The RUS Data Or The NRRI Study.

In the FNPRM, the Commission has proposed three major refinements to the NRRI Study: (1) for many equations, Ordinary Least Squares ("OLS") estimation has been replaced by a robust estimation known as the Huber adjustment; (2) in an attempt to account for differences between rural and non-rural carriers, the Commission has proposed a "superior buying power adjustment"; and, (3) because the RUS data only contained costs for 24-gauge copper cable, a method has been devised to estimate the costs of 26-gauge cable. As explained below, these refinements are not suitable, and do not overcome the shortcomings of the RUS data or the NRRI Study. Indeed, the Huber adjustment makes the resulting regression estimates even less representative of non-rural carrier costs than the original NRRI Study.

a) The Huber adjustment.

GTE disagrees with the application of the Huber adjustment. First, the Commission's characterization of the Huber adjustment is wrong. The Huber adjustment does not determine and/or exclude "outliers." Instead, by minimizing a more general distance function, it diminishes the destabilizing effects of outliers. Second, the goal of the Huber adjustment is to help estimate costs that would be incurred by the LECs. The problem with the NRRI Study is not the existence of outliers, but the lack of comparability to non-rural LEC costs and input prices. The proposed changes to the NRRI Study, through the use of the Huber adjustment, have not alleviated these problems and may make the analysis even less relevant for non-rural LECs. Third, the FCC states that "[t]he ordinary least squares technique is efficacious, however, only for a data set lacking statistical outliers."[43] As discussed in *A Guide to Econometrics* by Peter Kennedy, true outliers are valuable and, when present, the OLS adjustment is efficient, unbiased and should be used:

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[43] FNPRM at ¶ 75.

> Once influential observations have been identified it is tempting just to throw them away. This would be a major mistake. Often influential observations are the most valuable observations in a data set; if for years interest rates or relative energy prices do not change much, when they do change the new observations are exactly what is needed to produce good estimates. Furthermore, outliers may be reflecting some unusual fact that could lead to an improvement in the model's specifications.
>
> The first thing that should be done after influential observations have been identified is to examine these observations very carefully to see if there is some obvious reason why they are outliers. There may have been an error in measuring or classifying the data, or the data may have been entered into the computer erroneously, for example, in which case remedying these mistakes is the best solution; if a mistake cannot be remedied, then throwing an observation away is justified. There may be an unusual circumstance associated with an observation, such as an earthquake or an accountant's "extraordinary item," in which case some thought should be given to modifying the model to allow incorporation of this observation.
>
> If influential observations remain after this examination, it is not obvious what should be done. If as a result of this examination the researcher is convinced that these observations are bona fide and therefore valuable, OLS should not necessarily be abandoned....[44]

It is unclear whether the FCC or the NRRI Study authors inspected the RUS database for possible errors. Even if they did, a robust regression is not necessarily the preferred estimator simply because outliers are present. Furthermore, as discussed in another prominent econometric textbook:

> These [robust] estimators have found little use in econometrics, primarily because of the difficulty in implementing them and their largely ad hoc nature. Tinkering with the outlying observations amounts to letting the computer be the ultimate judge of the estimated relationship and diminishes the role of the underlying theory. Least squares remains by far the estimator of choice for the linear regression model.[45]

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[44] P. Kennedy, *A Guide to Econometrics*, p. 280 (3d ed. 1992).

[45] W. Greene, *Econometric Analysis,* p. 309 (2d ed. 1993).

These quotes illustrate that OLS estimators are more than adequate in fitting the data in the presence of outliers.

Robust estimators such as the Huber adjustment should also be considered only if the distribution of the error term is symmetric and has "fatter tails" than the normal distribution.[46] The FCC has not presented any evidence that either the symmetry or "fatter tails" condition has been satisfied. If such evidence does not exist, then the Huber adjustment was chosen without regard to the conditions that might justify a departure from OLS regression.

Because the FCC's proposed adjustment has not been supported by a review of the underlying data, there is no guarantee that it is a step in the right direction, and may lead to less efficient estimates of cable and structure costs. Even if a robust regressor were somehow warranted, the appropriate application is to *first* apply it to all the data, check for outliers, and then decide whether to reject or model them. Often it can be found that the problem, which seems to be a lack of robustness, is caused by other problems such as heteroskedasticity. Moreover, since the NRRI Study relies on RUS data only, it does not reflect the population of interest with respect to the Model. Consequently, even if an examination of the RUS data justified use of the Huber adjustment, it would not follow that the same estimation method is appropriate for non-rural carriers.

Additionally, the Huber adjustment diminishes the impact of the more expensive contracts in the data set, making the resulting estimates even less reflective of non-rural

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[46] The term "fatter tails" refers to a distribution in which it is more probable for an error observation to fall in the tail region of the distribution than in the normal distribution.

cost structures. The net result of the Huber adjustment is a set of parameter estimates that are largely based on data reflecting costs of essentially only the lowest density zone, where no extra placement difficulties are present. Since the Huber adjustment is also used to estimate structure costs, the structure costs produced by the Model are underestimated as well.

Finally, as noted earlier, the NRRI Study is based on an edited data set that excludes high-cost observations believed to be unrepresentative of RUS companies. By applying the Huber adjustment to this edited data set, the FCC is likely underestimating not only the costs that the RUS companies would incur, but also the costs of non-rural carriers. At a minimum, use of the Huber adjustment exacerbates the problems caused by editing the RUS data set.

b) The superior buying power adjustment.

The Commission has not provided a sound theoretical justification for its "superior buying power adjustment." In the first place, this adjustment cannot properly convert RUS data (that purport to reflect the costs of rural carriers) into costs for non-rural carriers when, in fact, the RUS data do not reflect of the cost structure of rural carriers. The starting point for the adjustment must correspond to the costs of rural carriers if the superior buying power adjustment is to have any validity.

Moreover, a properly specified regression analysis using a representative data set would account for any differences in buying power without having to resort to the adjustments proposed in the FNPRM.[47] In other words, if the regressions used to

[47] Adjustments for the different cable types are proposed in the FNPRM at ¶¶ 78, 79, 84, 91, 93 and 95.

estimate costs were based on data from a representative sample of companies, and if company size were included as an explanatory variable, then no separate buying power adjustment would be needed. In fact, using a large, representative sample is the only way to achieve regression estimates that are useful for the FCC's purposes.

Nevertheless, GTE reviewed the methodology and data used by the Commission to develop the proposed superior buying power adjustment, and has concluded that the application of the adjustment factors to the coefficients in the regression equations is contrary to the fundamentals of sound econometric analysis. It is econometrically unsound to adjust the coefficients of a regression in order to account for potential sample bias. If there is reason to believe that the estimates are inaccurate, then the data set should be supplemented (in this case by adding observations for non-rural companies) and the regression should be re-run.

The Commission proposes "to adjust the equation to reflect the superior buying power that non-rural LECs may have in comparison to the LECs represented in the RUS data."[48] The NRRI Study developed the following material adjustment factors for copper (aerial and underground) and fiber (aerial and underground) cables based on data entered from a proceeding before the Maine Public Utilities Commission: underground copper --16.3%; aerial copper -- 15.2%; underground fiber -- 27.7%;[49] and aerial fiber -- 33.8%. The FCC has tentatively concluded that these adjusted values

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[48] FNPRM at ¶ 78.

[49] Although the rounded value from the NRRI Study is 27.7%, the FCC is recommending a value of 27.8%. FNPRM at ¶ 93.

represent a reasonable estimate of the difference in the material costs that non-rural LECs pay in comparison to the RUS companies.[50]

Several flaws have infected the development of the superior buying power adjustment. First, the adjustment was developed with data from only one year, which provides no assurance that the data are representative of any time period other than that one year. Second, the RUS data are compared to only one company's data (Bell Atlantic) in one state (Maine). It is patently unreasonable to suggest that a nationwide superior buying power adjustment can be determined so simply and easily. The most that this calculation provides is a comparison of the costs between rural carriers and Bell Atlantic-Maine. To suggest that this adjustment reflects the superior buying power of all non-rural carriers is sheer folly.

Furthermore, it appears that the comparison of RUS and Bell Atlantic-Maine data is not an "apples-to-apples" comparison. Instead, the comparison is between Bell Atlantic's forward-looking TELRIC costs, and RUS contract costs dating back as early as 1986, indexed to a current period. This is, therefore, nothing more than a comparison of embedded rural LEC costs and non-rural forward-looking TELRIC costs.

There are numerous other data concerns that render the superior buying power adjustment invalid. For example, it is unknown whether the underlying data include items such as sales tax or shipping costs and, if so, whether the level of these items is comparable between Maine and the states included in the RUS data. There is also no documentation to substantiate the assumption that the types of cable used in Maine and

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[50] FNPRM at ¶ 79.

the RUS data were comparable.[51] The calculated adjustment is also suspect because some RUS observations (i) used in the determination of material costs are not used in the Model, (ii) appear to be from rescinded contracts or contracts excluded from the NRRI Study per foot cable costs calculation, and (iii) are for technologies that may not be appropriate for a TELRIC study.

Therefore, not only is the superior buying power adjustment not necessary if more representative non-rural cost data are used to develop inputs for the Model, but also the methodology used to derive this inappropriate adjustment is flawed.

c) Estimation of 26-gauge cable costs.

Because the NRRI Study contained no cost data for 26-gauge cable, the FCC proposes to estimate the costs of 26-gauge cable in a two-step process.[52] First, the Commission derives a ratio of costs for 24-gauge cable to the cost of 26-gauge cable from a regression equation that has this ratio as its dependent variable. Second, the inverse of this ratio is multiplied by the cost of 24-gauge cable, to produce an estimate of the cost of 26-gauge cable. The FCC proposal relies on the assumption that the expected value of the ratio of two random variables (in this case the costs of 24- and 26-gauge copper cable) equals the ratio of the individual expected values. However, for two random variables X and Y, it is well-known that: $E[X/Y] = E[X] / E[Y] - COV[X,Y] / \{E[Y]\}^2 + VAR[Y] \times E[X] / \{E[Y]\}^3$.[53] Consequently, using this ratio and an estimate of the

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[51] For example, it is not known whether the conductor insulation is PIC or Pulp, the cable sheathing is ALPETH or STALPETH, or the PIC cables are filled or unfilled.

[52] FNPRM at ¶ 85.

[53] *See* A. Franklin and D. Bobs, *Introduction to the Theory of Statistics*, p. 181 (3d ed. 1974).

cost of 24-gauge copper cable to compute an estimate of the 26-gauge cost will produce a biased result. The exact nature and magnitude of the bias will depend on the expected costs for both gauges of copper cable, the covariance between them, and the variance of 24-gauge cable costs for each set of placement conditions. In the absence of this information, there is no way to determine if the resulting costs for 26-gauge cable can be relied upon. The only way to avoid a biased estimate of 26-gauge cable costs is to estimate them directly. It is not possible to rehabilitate the limitations of the RUS data set in the manner proposed by the FCC.

4. The FCC's Specification Changes to the NRRI Study's Regression Equations Are Unexplained.

While the FNPRM indicates that only the Huber adjustment has been used to modify the NRRI Study results, the FCC has made several other changes that should not be considered unless and until they are fully explained. For example, the proposed equation to estimate 24-gauge buried copper cable and structure costs is a different specification than the equation reported in the NRRI Study's Table 2-7.[54] The FCC specification contains an intercept term that does not appear in NRRI Study and also excludes a variable, "watlin15," that takes into account water impact and was used in the NRRI Study equation. In addition, density is modeled differently. Because there is no documentation or explanation from the FCC, it is not clear why these changes make sense or should be accepted.

GTE has also determined that, in some instances, the FCC changed the form of the variables that were used in the NRRI Study. For example, the FCC's regression for

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[54] NRRI Study at p. 44.

24-gauge underground copper cable includes a squared term for number of copper cable pairs. This squared term is not in the corresponding regression in the original NRRI Study. Again, no reasons for these specification changes and no assessment of their effect on the estimated costs appear in the FNPRM. As shown in Attachment 3 to these Comments, the results of the FCC's equation for 24-gauge underground copper cable produces negative cable costs for pair sizes greater than 3,460. The modification of the equation by the FCC produces declining cable costs for pair sizes greater than 2,100 pair, resulting in the cost of 3,000 pair cable being less than a 400 pair cable. Surprisingly, these results from the regression equation do not flow through to the default inputs used by the Model.

What is strikingly apparent from Attachment 3 is the extent to which the results of the regression equations found in Appendix D of the FNPRM do not correspond to the proposed default input values in the Model. Although there is more consistency among the results of the FCC regression equations at the lower pair sizes, the discrepancy between the two increases as pair size increases. For example, the input values for buried copper cable (Column I and H) are consistently 35% less than the results using the equation in Appendix D for cable sizes greater than 600 pair. Given that this inconsistency between the equation results in Appendix D and the proposed input values, is evident throughout the cable costs proposed by the FCC, it is quite difficult to determine the basis of the proposed costs. Therefore, the costs should be rejected.

5. The Engineering And Splicing Loading Factors Are Improper.

As with the superior buying power adjustment, the proposed adjustment for LEC engineering and splicing costs is flawed and should not be adopted. GTE agrees that the proposed input values need to be modified through the use of engineering and splicing loading factors (or other means) because these costs are incurred by any carrier in the placement of plant. However, GTE does not agree that these factors can be properly developed based on the RUS data.

The NRRI Study does not include the same RUS contracts used in developing the splicing adjustment. As part of the superior buying power adjustment, the FCC develops different adjustments for underground (including buried) and aerial cable. The same splicing adjustment, however, is developed and applied to all copper cables, and separately for all fiber cables. This results in a "disconnect" when used in the Model equation. That is, the material price for copper cable will be discounted by different values depending on whether it is aerial, underground, or buried, but the resultant discounted price will have the same splicing percentage applied to it. The result will be that the splicing costs for the same size cable will vary according to the method of placement. Additionally, the RUS engineering codes suggest that the data set includes the cost of strand in the cable costs for aerial copper and fiber cables.[55] This being the case, it is clear that the use of a combined (aerial, underground, and buried) splicing factor applied to cable investment is not a reasonable representation for any of the cable types individually.

For the foregoing reasons, GTE recommends that the engineering and splicing loadings be based upon company-specific cost data from non-rural LECs.

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[55] GTE confirmed this directly with the NRRI Study's authors.

6. The Commission's Proposal for Switching Inputs Is Inadequate.

As with cable and structure costs, GTE recommends that the FCC use the company-specific data provided by the non-rural LECs to develop switch inputs to the Model, and not the switch data that include both the RUS and depreciation data. Switch investment data should be gathered or sampled in a way that includes both new switch installs and switch investments associated with adding new digital equipment to existing switches. Switch investments could then be developed by state, by company, by manufacturer, host/remote configurations and line size. GTE filed extensive comments in response to the December 1, 1998, workshop (incorporated here by reference) stating that the NRRI Study source data are outdated and inconsistent with regard to switch size.[56] Additionally, comments with regard to the use of the NRRI Study to develop switch costs is presented below in Section V.B.1, at pp. 63-64.

C. The Model's Optimization Routine Should Not Be Activated.

GTE does not agree with the FCC's conclusion that the Model should be run with the optimization routine activated. First, there is no valid explanation of how or why the value of –p500 was selected for the optimization factor.[57] Minimizing the computer run time -- the proffered justification -- is not a valid reason for using the –p500 value. The FCC's cost model criteria require that the Model's results be "plausible;" minimal computer processing time is never mentioned as a requirement, or even a relevant factor. Also, the optimization routine in the Model cannot be validated due to the near total lack of output detail required to determine the decision process being used. The

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[56] Universal Service Cost Model Docket, GTE Comments (Dec. 18, 1998).

[57] FNPRM at ¶ 58.

limited data available indicate that the optimization of the distribution network, using the Prim algorithm, does not work properly. Even if the validation and documentation conditions are met, GTE still has fundamental concerns regarding the use of a minimum spanning tree routine for developing the distribution network.

The Model's design of the distribution network using the optimization routine is flawed because no attempt was made to use public domain algorithms that tend to be well tested and well documented. There also has been no attempt to tie the distribution network to actual amounts of road feet in the area being modeled. Without documentation and external validation, unforeseen glitches in the algorithms can result in wildly unrealistic estimates of structure feet. Finally, the optimization routine should not minimize investment costs net of sharing because it is the life cycle cost of the total investment that should be minimized, not just the portion assumed by the ILEC. Application of the annual charge factors to just the post-sharing investment further distorts the true cost relationships.[58]

GTE's preliminary review of the results of the Model at the cluster level using optimization has uncovered disturbing results. The FCC's premise that "the [optimizing] algorithm functions by first calculating distribution routing using an engineering 'rule of thumb' and then comparing the cost with the minimum spanning tree result, choosing the routing that minimizes annualized cost" is not met.[59] There are numerous cases where the optimization routine for distribution has resulted in increased cost at the wire center level. For example, when the optimization logic is applied to clusters with less

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[58] *See* Section V.D.2, at p. 88.

[59] FNPRM at ¶ 57.

than 100 lines per square mile for GTE's Florida serving area, total monthly costs for eight CLLIs are higher than without optimization. The optimization routine is obviously flawed if the decision to select the least cost configuration is not executed correctly.

When changes were made in the optimization factor, numerous anomalous results were observed, such as a change in feeder length, customers being moved on and off DLCs, and changes in the relationship between structure feet and cost. It is difficult to ascertain exactly what decisions the Model is making without any inventory detail showing how much of each type of plant is placed.

The Model's use of a combination of complex algorithms mandates substantial validation and documentation. Because that has not happened with the current version of the Model, the distribution optimization routine should not be used and the Prim value should remain at zero, thereby disabling the Prim algorithm to optimize distribution plant.

D. The Rectilinear Distance Methodology Is Superior to Airline Distance.

GTE agrees that the Commission's proposed rectilinear distance methodology is superior to one based strictly on a route-to-air ratio because the rectilinear distance methodology does not impose the same route distances on nodes equidistant to the wire center.[60]

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[60] FNPRM at ¶¶ 62-63.

IV. THE COMMISSION SHOULD ONLY ADOPT CUSTOMER LOCATION INPUT DATA THAT HAVE BEEN FULLY DISCLOSED

A. PNR's Undisclosed Geocoded Data Should Not Be Used.

GTE supports the Commission's tentative decision to reject the use of geocoded data from PNR Associates, Inc. ("PNR"), and urges it to reject on a permanent basis any customer location data that are not available in their entirety for review.

PNR's customer location information, database, and underlying algorithms should not be used because they have never been fully disclosed to interested parties for review. The Commission long ago recognized that it is fundamental to the analysis of any cost model that the underlying formulae and computer software be available for review and comment, that "[a]ll underlying data should be verifiable, engineering assumptions reasonable, and outputs plausible," and that it permit the user "to examine and modify the critical assumptions and engineering principles."[61] As GTE has vigorously contended, the Model must not use PNR geocoded data because PNR has refused to make its data available for review, citing their proprietary nature.[62] GTE offered on numerous occasions to sign a confidentiality agreement to assuage PNR's concerns, but PNR refused to budge from its position that no one would be allowed open access to the geocoded data that resulted in the critical placement of customers. The concerns raised by GTE and other parties with regard to the "black box" nature of PNR's customer location data have been well documented in this proceeding. PNR

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[61] Universal Service Order at ¶ 250.

[62] Universal Service Cost Model Docket, Affidavit of Robert Clinesmith in Support of Petition of GTE for Reconsideration of the Commission's Fifth Report & Order (June 18, 1998) at pp. 3-6.

steadfastly contends that its geocoding methodology and underlying data (including the National Access Line Model ("NALM"), Dun & Bradstreet data, Metromail data, and the Business Location Research ("BLR") database) are highly proprietary and confidential. While PNR's classification of the customer location data as proprietary may be justifiable from a business perspective,[63] it is incompatible with the FCC's cost model Criterion Eight.[64]

Without verifying and validating the customer location data, one cannot assess the accuracy of the resulting network costs. GTE has stressed that the key to determining realistic cost estimates begins with a reasonably accurate identification of customer locations, especially in low density zones. It is widely recognized, however, that customer locations in the lower density (higher cost) exchanges are likely to be excluded from publicly available customer address databases, such as those used by PNR. This omission gives rise to a need by PNR to manipulate the customer location data to create a process that purportedly places these rural customers in the general vicinity of their actual location. GTE's efforts to obtain access to and learn precisely how PNR manipulates the data have been unsuccessful.

The Commission should now make its decision regarding the use of the PNR geocoded data final, and foreclose the use of any undisclosed data for determining customer locations. Compliance with the Commission's own cost model criteria would preclude not only the use of PNR's geocoded data, but also PNR's NALM. The NALM

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[63] Universal Service Cost Model Docket, PNR *Ex Parte* (April 12, 1999).

[64] Universal Service Order at ¶ 250.

is a proprietary model that allocates access lines to wire centers.[65] The Commission and PNR have refused to make the NALM available for review. The NALM must be made publicly available to enable interested parties to understand how the Model assigns access lines to wire centers, and whether that process is accurate. Understanding this process, and its accuracy, is as important to validating the Model as the accuracy of the geocoded data.

The Commission should also reconsider its tentative conclusion that PNR's road surrogate algorithm is preferable to the Stopwatch Maps algorithm.[66] Although neither the Stopwatch Maps' nor PNR's algorithm are without flaws, Stopwatch Maps' algorithm is more open and offers all parties a greater opportunity and flexibility to evaluate customer location data. One important difference between them is that PNR allocates *households* along roads, while Stopwatch Maps allocates *housing units* along roads. As GTE points out below in Section IV.B at pp. 39-44, it is imperative that the Model reflects the economies of scale experienced in building plant to housing units, not just households. The Stopwatch Maps approach is complete and, therefore, more accurate because it builds to housing units, which better reflects actual conditions. Also, by using housing units, the Stopwatch Maps data mitigate the Commission's concern about reflecting unoccupied housing units in the cost study.[67]

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[65] GTE believes that total access lines, including company official, should be used in determining the cost of universal service. Voice grade equivalent lines are not appropriate and should not be used in the cost calculation.

[66] FNPRM at ¶ 29.

[67] *Id.* at ¶ 46.

1. It Is Not Known Whether Surrogating Overstates Or Understates Outside Plant.

The Commission seeks comment on MCI's contention that "use of a surrogate algorithm may overstate the amount of plant necessary to provide supported services."[68] GTE asserts that no conclusions can be drawn at this point about the effects of using a road surrogate algorithm. Simply because costs are higher using the road surrogate data, it does not necessarily follow that the amount of outside plant is overstated. It is possible that the overlay of non-geocoded data on the geocoded base data may place customers on top of each other, thereby overstating the density of a particular area and leading to an understatement of costs. Comparing a cost result from 100% surrogate data to an understated cost level might lead one to incorrectly conclude that the amount of plant is overstated. In order to perform a valid test of the road surrogate algorithm, one would need to first validate the "base case" results from using a mix of geocoded and non-geocoded data. Unfortunately, these results, which form the basis of MCI's approach, cannot be validated due to PNR's refusal to disclose the underlying data and algorithm.

B. The Modeled Network Should Serve All Housing Units, Not Merely Households.

Housing units, not households, should be used to design the modeled network.[69] GTE therefore disagrees with the FCC's tentative conclusion that customer locations

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[68] *Id.* at ¶ 34, citing letter in the Universal Service Cost Model Docket from Chris Frentrup, MCI, to Magalie Roman Salas, FCC, dated February 19, 1999.

[69] Universal Service Cost Model Docket, Affidavit of Francis J. Murphy in Support of Petition of GTE for Reconsideration of the Commission's Fifth Report & Order (Dec. 18, 1998), at ¶¶ 64-67.

should be based upon PNR's estimate of households.[70]

In the real world, outside plant engineers design distribution plant based on housing units, not households. This allows them to design a network that can provide timely service to all customers in a serving area, and allows the carrier to satisfy its carrier-of-last-resort obligations. A cost model designed to capture the forward-looking, long run cost of a telephone network should adhere to the same principle.

In the Universal Service Order, the FCC laid out ten criteria for a forward-looking cost model. The FCC's cost model Criterion 1 states, in part, "[t]he loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services." [71] Building a network that serves only households, as suggested in the FNPRM, would impede the provision of both supported and advanced services. The first time any service is requested at a new or recently occupied housing unit not served by the plant built only to "households," will require that expensive and disruptive construction projects will have to be initiated. The time that it would take to build new plant to these units would result in violations of the stringent requirements that most state commissions place on service delivery intervals.

The proposed use of households clearly conflicts with the requirement that costs be based upon the least-cost, most efficient forward-looking network design. The least-cost, most efficient loop design is one that builds distribution plant to serve the ultimate demand in an area, i.e., housing units. Building a forward-looking network requires an engineer to plan not only for future demand, but also for periodic shifts in demand. For

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[70] FNPRM at ¶ 43.

[71] Universal Service Order at ¶ 250.